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OPTIMUM WATER YEAR

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UNDERSTANDING
MILK'S PROTEINS

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*Woman
Scientist
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U.S. Department of Agriculture

AGRICULTURAL Research

Vol. 7—April 1959—No. 10

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Value

One of our most important jobs has won new recognition. That job—given USDA by Congress two-thirds of a century ago—is to study our food from the viewpoint of consumers and to find out what to eat to maintain life and health.

The scientist who has guided this quest for many years, Hazel K. Stiebeling, recently received from President Dwight D. Eisenhower the Gold Medal Presidential Award for Distinguished Civilian Service. It's a tribute to work that has earned the Department a worldwide reputation.

This job, of course, makes USDA more than a department of agriculture serving farmers alone. We are also a department of food serving the whole Nation.

Scientists of our Institute of Home Economics are looking into the nutritive values and other qualities of different foods, and what happens to them in cooking. Functions and interrelationships of nutrients in the body are under investigation. Surveys are telling us what various population groups eat and why. And we're evaluating shifts in food consumption and how they may affect the demand for agricultural products.

The findings, which cost less than a penny a person yearly, help many groups. Farmers and marketers get a better idea of the products our families need and want. Teachers and extension workers can advise consumers more intelligently on selecting and using products. Homemakers the country over are guided in the best use of their time and money.

But, as Dr. Stiebeling points out, we have much to learn. For example, the human body must get some 50 chemical substances from foods. Yet, for only a fraction of these can we now estimate how much people need at different stages of growth and development, and under various conditions.

We also have much to learn in other areas—clothing and textiles, housing and equipment, family economics and home management—where notable research is under way.

These direct contributions of science to improvement of our standard of living are an important consideration in a society that puts high value on advancing human welfare.

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

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Hazel K. Stiebeling has made lasting contributions to human-nutrition science and provided leadership in activities to help all people improve their diets

WOMAN SCIENTIST EXTRAORDINARY

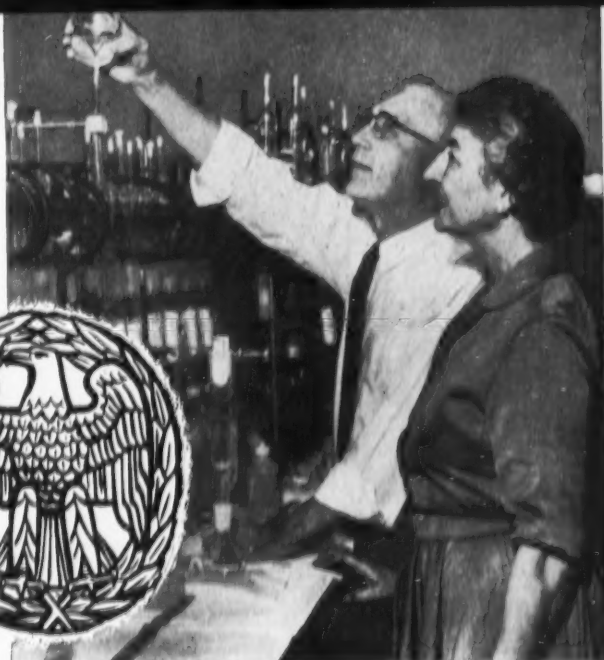
First woman to receive the Gold Medal Presidential Award for Distinguished Civilian Service is Hazel K. Stiebeling, Director of the ARS Institute of Home Economics.

Other recipients of the medal this year were James V. Bennett, Director, Bureau of Prisons; Robert D. Murphy, Deputy Under Secretary of State for Political Affairs; Doyle L. Northrup, Technical Director, Air Force Special Weapons Squadron; and Wernher von Braun, Director, Development Operations Division, Army Ballistic Missile Agency.

Dr. Stiebeling, an Ohio farm girl, got her B.S. and M.A. degrees from Teachers College, Columbia University. Her Ph. D. in 1928 from Columbia was in chemistry. She holds honorary LL.D. degrees from Skidmore College and Michigan State University, and a D. Sc. degree from Iowa State College.

Other honors include the 1943 Borden Award through the American Home Economics Association, USDA Distinguished Service Award, public-service commendation by the Ohio General Assembly, and honor citation from the National Dairy Council. She is an honorary national member of Omicron Nu, Phi Upsilon Omicron (honorary), and the American Dietetic Association, and honorary fellow of the Italian and Chilean Nutrition Societies.

Dr. Stiebeling belongs to the American Institute of Nutrition, Sigma Xi, the American Chemical Society, the American Statistical Association, American Home Economics Association, the American Association for the Advancement of Science, the Washington (D.C.) Academy of Sciences, and the American Association of University Women.



DR. STIEBELING watches as E. W. Toepfer demonstrates hydrostatically operated electric switch developed to permit safer operation of the Soxhlet apparatus in fat studies.

■ A SCIENTIST WHOSE WORK is respected throughout the world, Hazel K. Stiebeling never loses sight of the human being and how science can bring better health and better living to people everywhere.

She sums up her career urge as "Food for life—an eternal concern of women." This purpose was expressed as a child in helping her mother prepare the family's food, in her early teaching of domestic science and nutrition, and in her own research in nutrition. It motivated her efforts in USDA to apply science findings to daily living, and her leadership in international nutrition and home economics activities.

For her lasting contributions to the science of nutrition, President Eisenhower gave her, on January 20, the President's Award for Distinguished Federal Civilian Service. This is but the latest in a long succession of honors. She takes them humbly, saying, "The award is a tribute to my staff." This attitude discloses one of the secrets of her success—her appreciation and recognition of others' contributions.

Her studies at Columbia University with Professors Mary Swartz Rose and Henry C. Sherman added much to knowledge of vitamin D and other nutrients. Her work, with that of others, has given us knowledge to help children everywhere grow strong bones and healthy bodies.

Dr. Stiebeling's first special assignment after she entered USDA in 1930 was to help plan for emergency feeding of drought-stricken farm families and city families affected by the economic depression. Her understanding of human values led her, in planning food for nutrition needs, to emphasize the foods that people were familiar with.

This job led to a bigger one—developing food plans for many different situations. She grouped together foods making similar dietary contributions and combined the groups in patterns to satisfy body needs.

WOMAN SCIENTIST EXTRAORDINARY

(Continued)

This technique has been widely used in drawing up food plans to meet changing conditions of supply, incorporate new nutrition findings, and make use of new food products. Over the years, the resulting food plans—geared to different economic situations—have proved invaluable tools for extension workers, teachers, nutritionists, and others who help families plan food supplies and meals.

"Food for Fitness, a Daily Food Guide" is the latest popular publication to help people choose adequate diets (AGR. RES., May 1958, p. 6).

For a number of years, Dr. Stiebeling directed nationwide investigations of what people eat and of the nutritional adequacy of their diets. A 1936

survey revealed that one-third of families in the United States had diets that were considered "poor" nutritionally. The most recent survey indicates considerable improvement, with probably as few as 1 in 10 having a poor diet by 1936 standards (AGR. RES., May 1957, p. 12). Survey findings give direction to school lunch and educational programs.

Administrative scope is broad

Dr. Stiebeling now administers ARS home economics research that advances knowledge of food and human nutrition, clothing and textiles, housing and household equipment, and household economics. She has demonstrated vision in anticipating national problems and needs, and ability to direct research to meet them.

The research findings help those who produce and market goods and

services to understand better what families need and want. Teachers and writers base educational work on the findings, and homemakers use them in caring for their families.

Many scientists and teachers from other countries come to consult Dr. Stiebeling. She serves on FAO committees and on U.S. delegations to international conferences, suggesting ways to help people help themselves to attain better living. Her travels have taken her to many parts of the world.

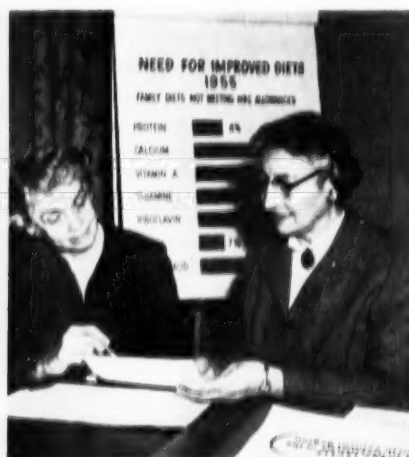
Dr. Stiebeling enjoys music and the theater. She likes biography and selects books and plays that "help me understand life a bit better."

She thinks there is no field more challenging than nutrition and home economics and that none offers a greater opportunity for service.

Nutrition is daily concern

"We need to learn more about how to motivate people to use in every day living the principles of nutrition we already know," she says. "People do not always associate their diet with their sense of well being. The effects of good or poor diets are interrelated with other environmental factors, and may show up slowly."

As for future nutrition research, Dr. Stiebeling says: "We need more information about the nutritive contributions that different kinds of foods can make, about human needs for various nutrients, and about the functions and interrelations among nutrients. We have much to learn about the full potential for vitality and well-being that might come from a better proportion among nutrients or larger amounts of some nutrients." ☆



NUTRITIONAL ADEQUACY of United States diets as shown in USDA survey is discussed (left) with Esther F. Phipard. Dr. Stiebeling brings research results to members of Inter-Agency Committee on Nutrition Education and School Lunch (below). These nutritionists, with State and local workers, take findings to people.



MEMBER OF FAO/WHO Joint Advisory Committee on Nutrition, Dr. Stiebeling here checks report at 1949 Geneva meeting—later attended two meetings in Rome. She also served on FAO/WHO Expert Committee on Protein Requirements, on first FAO Advisory Committee on Home Economics, and on 9 out of 10 U.S. delegations to FAO conferences. She headed two U.S. delegations to FAO regional conferences in Latin America.

CYTOPLASM CAN ALTER GENETIC EFFECTS

Some plants' characters are influenced by the nongenetic plasm of the cells

■ IT ISN'T JUST THE GENES that count—at least in corn—say USDA-State scientists.

Since discovery of Mendel's laws of inheritance and the identification of genes as the units of heredity, plant breeding has been based on the kinds of genes in the parent stock. Recent studies suggest plant breeders may now have to reckon with the influence of another cell constituent—cytoplasm—on genetic characteristics.

In tests at the Ohio Agricultural Experiment Station, Wooster, USDA agronomist G. H. Stringfield found that cytoplasm affected yield and ear height in corn. This could make a difference in selection of the maternal parent for hybrid crosses, because cytoplasm is contributed to the seed almost solely by the mother plant.

A well-known cytoplasmic influence is the one causing male sterility in corn. Some workers believe cytoplasmic male sterility (CMS) to be a hereditary character controlled by the cytoplasm rather than the genes. But the discovery of a gene that restores fertility in plants having the so-called CMS cytoplasm has led some workers to another view. They think the cytoplasm may not transmit hereditary characters but, like the outside environment, may modify the expression of a gene or of the entire genetic makeup of a plant.

CMS cytoplasm has been used to good advantage in the production of hybrid corn because this cytoplasm saves the seed producer the work of detasseling plants. The restorer gene is bred into the seed sold farmers.

Several cytoplasm have been found to cause male sterility. In his experiments, Stringfield compared a CMS cytoplasm from Texas with some Corn Belt cytoplasm.

Ear height varies with different cytoplasm

Cytoplasmic influence on ear height showed up in comparisons of plants of the same genetic makeup (genotype) but different cytoplasm. Three inbred CMS lines were crossed reciprocally with four inbred lines having cytoplasm not known to be associated with male sterility.



VISIBLE DIFFERENCE between CMS male-sterile and male-fertile corn plants shows up only in tassels at pollen-shedding time. Pollen sacs of male-sterile tassel (left) hold aborted and degenerated pollen grains. Pollen sacs of male-fertile tassel (right) are well filled with normal pollen ready to shed.

Ear height in most cases was lower for plants having the CMS cytoplasm. Statistically significant differences were shown in 3 of the 12 crosses. The effect of CMS cytoplasm, however, was not consistent in each cross, indicating that a particular cytoplasm has a greater effect on some genotypes than on others.

In another experiment, yields of CMS male-sterile plants were compared with yields of restored-fertile plants. The restored-fertile plants showed a consistent advantage in yield. Five different lines of plants, each having a dominant gene for restored fertility, were crossed and backcrossed with plants having the CMS cytoplasm, giving a total of 30 populations. The F_1 and backcross generations segregated into male-sterile and male-fertile plants. Dry ear weight ranged from 9 to 30 percent higher for the male-fertile plants.

Stringfield does not believe use of CMS male-sterile plants in hybrid production should be discontinued on the basis of this work. The studies show, however, that it may pay to explore cytoplasmic effects further. ☆

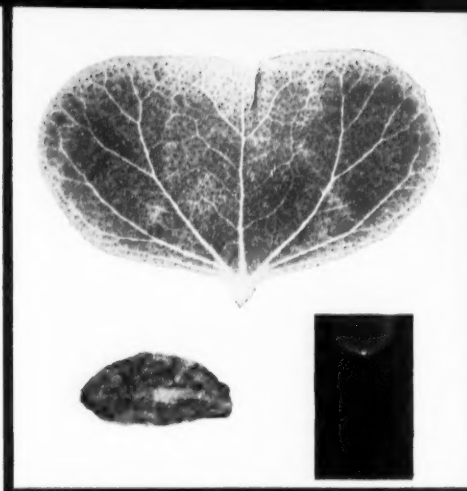
GETTING RID OF GOSSYPOL

**Breeding chemical
out of cotton plant
is improving quality
of meal and oil**

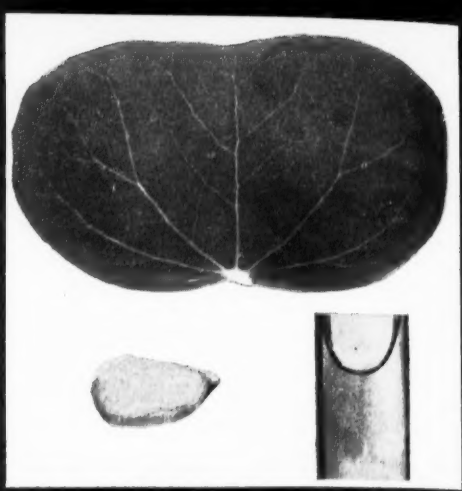
■ COTTONSEED'S TROUBLESOME pigment glands are on the way out. The glands are useless to growing cotton plants and contain gossypol, a yellowish chemical that lowers cottonseed meal and oil quality. Though latest processes remove most of the gossypol from seed products, or render it harmless, it would be more practical and less costly to remove the glands from the plants through breeding.

As a first step, USDA research has developed gland-free cotton strains, after years of breeding. The experimental plants are teaching us more about gland inheritance and the possible relationship of glands to favorable plant traits. This knowledge may enable us to breed glandlessness into commercial varieties and thus improve cottonseed product quality.

Seed in all commercial varieties today have pigment glands that contain gossypol, a phenol-like chemical. Gossypol in cottonseed meal is toxic to animals other than ruminants and must be chemically inactivated or removed before feeding to swine or poultry. USDA and cotton industry scientists have done much to improve oil and meal processes. But some methods of removing gossypol from seed meal also remove part of the protein, and thus reduce feeding value.



VISIBLE dark gossypol glands in this seed are betrayed by similar glands in leaf. Toxic chemical lowers value of crude cottonseed oil and meal for livestock feed.



SPOT-FREE leaf and seed are evidence that breeders were successful in eliminating gossypol from this plant. Clear oil in vial was obtained without refining.

In processing cottonseed oil, it's difficult and costly to remove gossypol, which is unstable. Ordinary refining leaves small amounts in oil. These residual particles decompose in the standing oil and discolor it, so extra refining and bleaching are needed to meet grade standards.

Low-gland strain gave us start

ARS geneticist S. C. McMichael, of the U.S. Cotton Field Station at Shafter, Calif., has developed glandless cotton plants and several strains with very few glands. Some cottons have an apparent genetic potential for glandlessness. McMichael observed that the number of glands is variable in a primitive cotton (Hopi Moencopi, which was grown by Arizona's Hopi Indians). So he crossed this low-gland cotton with a commercial variety and carried the progenies through several generations of selection and inbreeding. At each stage, McMichael retained only plants with reduced numbers of glands and, in this way, produced progenies with fewer and fewer glands. One completely glandless strain and several strains with few glands evolved from thousands of screenings.

Cooperative experiments at ARS and State laboratories have already

shown that oil from low-gossypol seed has superior color and grade. Other tests have shown that seed meal from these new lines is an excellent protein source for swine and poultry.

Breeding stocks of low-gossypol lines developed at Shafter have been made available to scientists of State experiment stations, private institutions, and cotton organizations. The scientists, however, do not know how difficult it will be to combine glandlessness with the present disease resistance and the quality and yield of lint, the main product.

McMichael's success, however, has cleared up several unknowns in cotton inheritance and will greatly help. For example, breeders now know that pigment glands are not essential to the plant's metabolism or in forming oil or protein. In general, the studies indicate good prospects for ultimate success in combining glandlessness, or reduced number of glands, with commercial cotton's agronomic and quality characteristics.

Better byproduct means millions

New varieties must, of course, hold the high standards of the main product, lint, but freeing the seed byproduct of gossypol would offer a bonus of several million dollars a year. ☆

How To Control Peanut Stem Rot

Two simple cultural methods reduce disease and increase yield by denying the fungus a favorable medium for buildup

■ CULTURAL PRACTICES developed for control of stem rot in bunch peanuts are just as beneficial for runner varieties. In cooperative USDA-State tests at the Virginia Agricultural Experiment Station, bunch and runner varieties gave similar results. Infection was lower and yields higher under the new system of soil preparation and cultivation than under conventional methods.

The control measures, based on the concepts of plant pathologist L. W. Boyle, of the Georgia Agricultural Experiment Station at Experiment, consist of two simple practices: (1) Covering of surface litter 4 to 8 inches deep in preparing the seed bed; and (2) cultivating carefully in order to avoid throwing soil against the plants, together with pre-emergence herbicide treatment to curb weeds. Conventional methods of seedbed preparation leave much trash near the soil surface. The standard method of weed control is dirting (throwing soil around the base of plants).

Stem rot (southern blight), one of the most widespread and destructive diseases of peanuts, is caused by the soil-borne fungus *Sclerotium rolfsii*. The fungus lives on or just below the soil surface on crop debris, from which it transfers to living plants. Stems, branches, and the pod-bearing stalks (pegs) of peanut plants are subject to infection. Deep covering, along with careful tillage to avoid dirting, denies the fungus the dead plant material on which to get started.

New methods compared with standard practices

ARS pathologist K. H. Garren and agricultural engineer G. B. Duke tested the new methods at Holland, Va., in comparison with surface mulching (leaving trash in the top 4 inches of the soil) and dirting.

In tests of the runner variety, plots cultivated by the control measures showed 3.9 percent infection and yielded 3,684 pounds per acre. But comparison plots cultivated by conventional methods showed 14.3 percent infection and yielded 2,747 pounds per acre.

Bunch peanuts gained about the same in yield but had a more striking reduction in rot. With control measures, infection was 3.4 percent, yield 3,364 pounds per acre. Under conventional cultivation, infection was 26.7 percent, yield 2,584 pounds per acre.

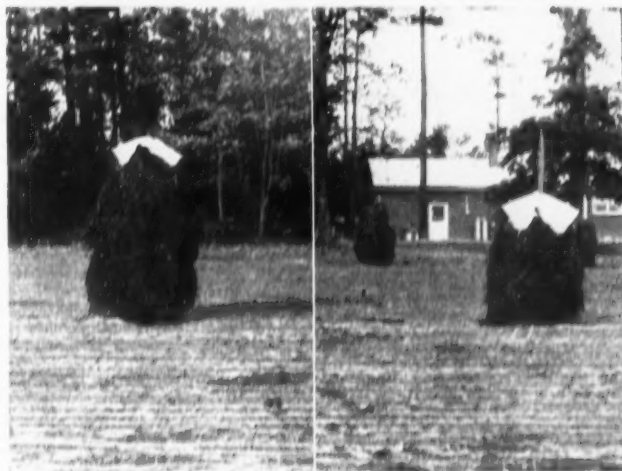
Deep covering and avoidance of dirting are the most practical controls for stem rot in most peanut-growing

areas. Incidentally, keeping excess dirt away from the row may also give the plant a better chance to branch freely. Where soil is subject to severe wind erosion, deep covering of organic trash might not be feasible.

Peanut breeders have been seeking resistance to this disease for more than 30 years, but to date very little proven resistance has been found. However, runner varieties have generally been considered somewhat less susceptible to stem rot than bunch varieties.

Since we have no varieties resistant to stem rot, this disease is an ever-present threat to peanuts. ☆

TYPICAL CULTURE, heavy infection, and reduced yield are reflected in peanut shock at right. Equal-size plot with new management, little disease, yielded twice as much (left).



PARTIALLY COVERED stem, infected by fungus growing on surface trash, is disease bridge to uncovered parts of plant. Piling dirt against plant is important factor in stem rot.





DIKES enclose small natural watersheds (outlined) at ARS Watershed Hydrology Station at Coschocton, Ohio, direct flow to gaging devices at foot of slopes. Runoff study refines our knowledge of rainfall-groundwater-runoff relations usable for small, ungaged watersheds.

Hydrologists have learned that they can develop the most meaningful data on streamflow and flooding potentials of a watershed if the season of maximum ground-water recharge starts a period called the

OPTIMUM WATER

■ AN OPTIMUM WATER YEAR—new concept in watershed analysis—can help hydrologists and others plan water conservation and manage a basin's land resources.

Like calendar and fiscal years, a *water year* is a grouping of months for a specific purpose—in this case, for analyzing data on rainfall, soil moisture, and streamflow of an area. The time you start the statistical year makes a difference in how reliably you can discern a true streamflow pattern, the basis for water-control design and specifications. Public agencies give technical aid to watershed planners and also pass judgment on water-control projects financed under the Watershed Protection and Flood Prevention Act.

USDA scientists have found that starting the annual period for record analysis when ground recharge is highest makes it possible to predict more accurately the seasonal changes in soil moisture and in water runoff. For larger stream basins, long-term rainfall and runoff records are generally available and can be used in making reliable and usable estimates of water yield. Unfortunately, basic runoff data from smaller upstream agricultural watersheds are scarce, though the need is urgent. The concept

of an *optimum water year*, however, allows planners to estimate runoff when rainfall records are the only water data available.

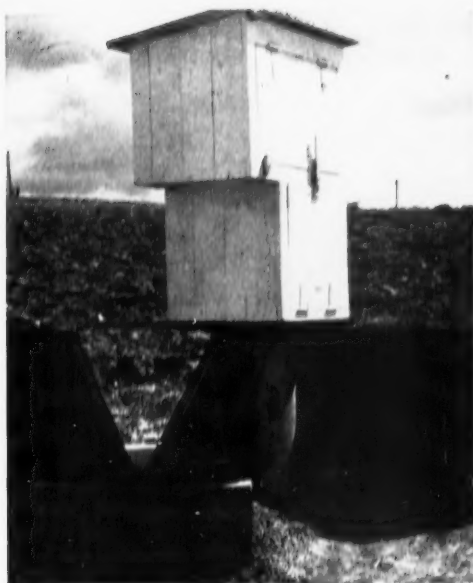
Small-watershed planning calls for more data

Demand for accurate estimates of water supply from smaller watersheds has grown enormously in recent years, as industry and urban developments in headwater areas continued to expand, while rural water needs, particularly for irrigation, also increased.

You can plan maximum supply for all water users in the smaller watershed, however, with incomplete records. It takes annual streamflow estimates, for example, to plan a reservoir, but planners could fall back on well-known rainfall-runoff relations that apply in all watersheds. And it is also possible to apply such relationships from a gaged watershed to the ungaged area.

The optimum-water-year concept greatly refines rainfall-runoff relationships and estimates based thereon.

Runoff and rainfall data for an annual period or water year are used to predict how certain land uses and conservation practices affect runoff. For many small agri-



AUTOMATIC devices in instrument house record a small watershed's runoff as it passes over H-type flume.



STREAMFLOW from several small watersheds—perhaps as large as 100 acres—is measured downstream as it passes over Parshall-type flume.

WATER stage recorders in instrument houses supply data for calculating runoff. The clock at right records rise and fall of float suspended to stream level.



ER YEAR

cultural watersheds, annual runoff and rainfall are nearly balanced. Knowing that they are in balance and being able to calculate any change in the balance for a year is the key to predictions.

Usually, annual water-year records have arbitrarily been started in the fall when soil moisture is lowest. But studies of actual soil moisture data over 12 years at the ARS Watershed Hydrology Station, Coshocton, Ohio, showed that moisture level at most times of the year is variable from year to year. They showed, however, minimum year-to-year variation in spring ground moisture compared with the larger fall change.

Usual data year has a disadvantage

This comparison illustrates the disadvantages caused by the variable fall level. That is, analysis of annual records based on the fall starting time would need to account for large variations in ground storage at the beginning and end of the water year, before the runoff-rainfall balance could be calculated. Such accounting would be impractical in most watersheds, for it could be made only with actual soil moisture data.

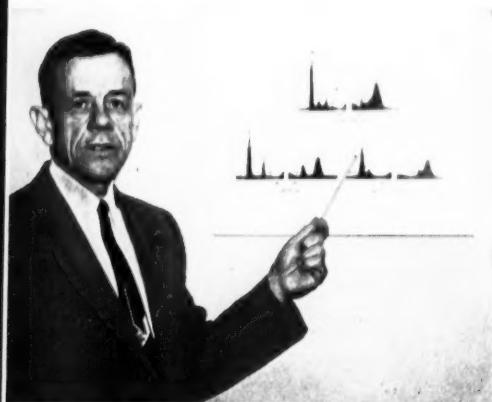
To prove spring rainfall and runoff data reliable in calculating water balance at Coshocton, ARS hydrologist D. L. Brakensiek tested various water years starting in different months. Ground moisture was most stable in years starting March 15, when soil moisture is greatest. At Coshocton, this technique was practically equivalent to using detailed soil moisture data. The average change measured a fraction of an inch.

Spring start is best for several states

From data on seven other watersheds in Nebraska, Texas, Missouri, and Illinois, Brakensiek found that the optimum start varied from April to June, depending on when ground moisture was highest. These are areas where rainfall and runoff are highly correlated.

By proving the balanced relationship between annual rainfall and annual runoff in many small agricultural watersheds, Brakensiek demonstrated the optimum water year's usefulness for predicting runoff. This concept is not only useful in predicting runoff for small sheds, but also adds to the competence of all water specialists for overall watershed planning. ☆

UNDERSTANDING MILK'S PROTEINS



T. L. McEekin discusses chart showing proportions of alpha-, beta-, and gamma-casein in skim milk and the proteins of whey. Components were separated by electrophoresis. Light passing through solution projects masses as shaded areas on sensitized paper.

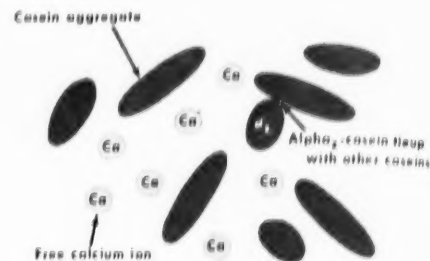
We are learning what these limited components are and how they complicate our job of processing and handling milk

■ THE RECENT DISCOVERY by USDA researchers of a new protein in milk may well provide a clue to one of the most perplexing questions in milk processing: Why do some processed milks tend to gel in storage?

The new protein—alpha₂-casein—differs chemically from other milk proteins and reacts differently than they do under certain conditions.

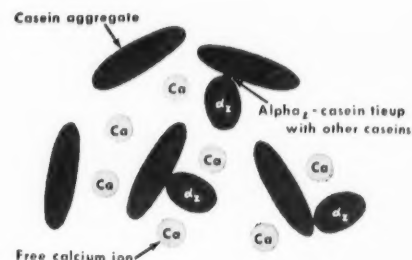
This finding is only the most recent development, however, in long-range basic research on milk proteins at USDA's Eastern utilization division, Philadelphia, Pa. Studies here have

CALCIUM CAN CAUSE GELLING OF CONCENTRATED MILK, BUT . . .



With normal amount of alpha₂-casein (α₂)

ALPHA₂-CASEIN CAN TIE UP OTHER CASEINS' CALCIUM BONDS



With experimentally added alpha₂-casein (α₂)

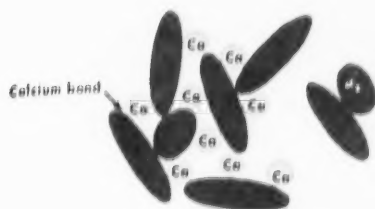
tein that accounts for 30 percent, with the rest divided among at least four proteins, including the newly-isolated alpha₂-casein. This new protein has only 0.1 percent phosphorus instead of the 0.85 percent in the major alpha-casein constituent.

The gelling in storage of some concentrated milks sterilized by heat is one puzzle that needs solving. The scientists are seeking the cause of this behavior in the milk proteins that have been identified and studied. One intriguing fact is that most of them are precipitated by a small amount of calcium salts, but the new alpha₂-casein is not. This fact may be important in stabilizing milk's calcium-casein complex.

Study centers on proteins

Not only are the chemical and physical properties of milk proteins being

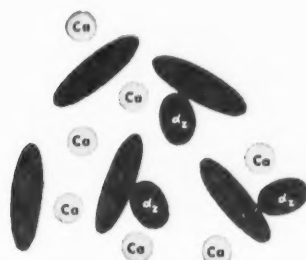
After Storage



Gelatinized mass



After Storage



Unchanged fluid



examined. Scientists know that various amino acids make up the long-chain chemicals in a protein molecule. By using certain enzymes and acids, the scientists hope to show the exact location of the amino acids in the molecule and the important phosphorus links in these acids.

The long-range value of this work to the dairy industry is reflected by the many times ARS scientists have received the prized Borden Award for outstanding research in milk chemistry. The \$1,000 and gold medal, given annually for the last 20 years, have gone to ARS researchers 8 times. This award is administered by the American Chemical Society.

Honors this year go to biochemist C. A. Zittle of the Eastern laboratory, for his studies on the effect of heat on the stability of milk proteins under various conditions. His work has

contributed to a better understanding of the changes occurring during heat processing of milk and may lead to improvement of quality of concentrated milk products.

Several workers share honors

Other ARS award winners are: W. G. Gordon, who won in 1958; S. R. Hoover, 1956; T. L. McMeekin, 1951; G. R. Greenbank, 1949; B. H. Nicolet, 1944; E. O. Whittier, 1943; and G. E. Holm (deceased), 1942. Nicolet and Whittier are retired. The other five are still with the Eastern division.

Gordon's award came as a result of his work in isolating and characterizing various milk proteins.

By using chemical substitutions and blocking certain chemical groups, Hoover showed that individual amino acids in the casein molecule, not the

entire molecule, were responsible for absorbing water, and showed where the absorption takes place. Hoover also determined the drying properties of the various casein derivatives. This information is useful in manufacture of casein fibers.

McMeekin's basic studies in isolation of various protein components brought him his award. He worked out chemical methods to separate alpha- and beta-casein, and isolated the gamma fraction in casein. McMeekin also found practical chemical ways to manufacture acid-precipitated casein. His studies on the hydration of proteins have had far-reaching significance, since proteins in living cells normally exist in a water environment. He showed specifically the water content of large beta-lactoglobulin crystals and the passage of sugar and salt into these crystals.

Earlier work laid foundation

Award-winning work by Greenbank established many guideposts for researchers and the dairy industry. He showed that heat treatment improves milk's baking quality, that "oxidized flavor" in market milk is in fact caused by chemical oxidation, and that homogenization improves keeping quality of dried whole milk.

Nicolet's award was for his studies of the casein amino acids containing sulfur and hydroxy. He developed the first analytical method for determining the presence of the then-new amino acids serine and threonine.

Whittier conducted basic studies of lactose and casein, and applied studies on the production of artificial fiber from casein.

And Holm's work on oxidation of butterfat in dairy products brought him the award, as well as his finding that clarification of whole milk improved keeping quality. His studies on the stability of proteins to heat were important to the development of an improved evaporated milk. ☆

These Feeder Calves are CERTIFIED

*Their index for gainability
shows superior feeder quality*



■ BUYERS OF MONTANA'S certified feeder calves don't exactly get a satisfaction-assured-or-money-back guarantee with their purchases. They don't have to. For a certified feeder plan in that State, soundly based on research findings of USDA and range States, is producing cattle the livestock feeders can depend on. These cattle grow faster, use less feed, and create more profit. What cattle feeder can resist *that* combination?

The plan supervised by the Montana Beef Performance Association is the

VERDICT of association graders is that yearling heifer is just good enough to stay in purebred herd. She weighed 998 pounds at 19 months. Her true worth will show in calf due in spring.

IPR CERTIFICATE shows this bull's topnotch qualities. He is a big bull, a fast gainer, grades high on quality and conformation, and comes from a good mother. He could sire really good calves. All records are certified by impartial association officials.

only one for certification of feeder cattle. The association got its clues on improving livestock directly from cooperative studies by the ARS Range Livestock Experiment Station at Miles City and the Montana Agricultural Experiment Station at Bozeman. The Miles City scientists have long worked with the northwestern range States to prove that performance testing is profitable for range cattlemen. At least 25 States use some kind of performance testing based in some measure on this work. Certified calves will usually wean heavier, grow faster, and be thriftier. We can be pretty sure of this, because they're sired by the best gain-tested bulls available.

Gains for every one of these bulls are recorded for the first winter, and yearlings are indexed by a scoring system much like that used in scoring a human's IQ. If a bull gains 10 percent better than the average of his particular group, he gets an index of 110 and his calves should grow a little heavier. Conversely, a bull with an index of 80 will probably sire disappointing calves.

Record is best buying guide

This is really taking the guesswork out of the unpredictable job of buying feeders on appearance. They may eat up everything in sight and still be slow in putting on weight. It's not hard to convince herd owners of the value of certification. When they pocket an extra 2 to 6 cents a pound for their certified feeders—as they've done in Montana—even skeptics become firm believers.

To join the association, you pay a small fee, use only bulls that have been indexed and quality graded, and you're in. An association fieldman checks occasionally, takes all necessary records, and makes sure that you *are* using indexed bulls and that the herd meets standards. If you meet all requirements, you'll get an

Montana Beef Cattle Performance Registry Association MSC, Bozeman, Montana			
INDIVIDUAL PERFORMANCE RECORD			
THIS IS TO CERTIFY: That the following described animal,			
Bred by <u>I. M. Breder</u>		Address <u>Ranchtown</u>	
Tattoo * <u> </u> R.E., <u>745</u> L.E.; Sex * <u>M</u> ; Born <u>3-23</u> 19 <u>56</u> ; Breed <u>Hereford</u> .			
has made the following record:			
Birthweight (actual) (estimated) <u>83</u> pounds			
NURSING INDEX (No. in group <u>53</u>)	Weaning Date <u>11-1-56</u>	Nursing Daily Gain <u>2.00</u>	Nursing Index <u>113</u>
	Initial Weight <u>660</u>	Daily Gain <u>3.00</u>	Gain Index <u>130 (R)</u>
GAIN INDEX (No. in group <u>16</u>)	Final Date <u>5-13-57</u>	Final Weight <u>1110</u>	Yearling Wt. Index <u>117</u>
YEARLING WT. INDEX (No. in group <u>16</u>)	YEARLING GRADE <u> </u> Date <u>5-13</u> 19 <u>57</u> , Grader <u>EPO</u>		Certified <u>2+</u>
The above designated * records are true and correct to our own knowledge as entered. Any erasure or alteration invalidates this entire certificate.			
Date <u>5-13</u> 19 <u>57</u> Signed <u>Signed</u> Secretary			

individual performance record (IPR) for each bull and a certificate for each group of feeders.

The IPR shows the bull's birthdate and weight, gain index (rate of gain in relation to group average), yearling weight index (his growth rate compared to that of other animals in the group), nursing index (his dam's nursing index as a producer of milk for her calves), and yearling grade (conformation and quality as judged by the fieldman).

About the same information appears on the certificates for sires' offspring feeder calves, in addition to the class of the feeders. For instance, Class A feeders are those from bulls

with a gain index of 110 or better; Class B, from bulls with an index of 100 to 109. Optional classes A and B Choice (where herds are sorted and culled for high conformation) give an added guarantee of high quality and conformation in the feeder calves that have been so certified.

Nursing index is important

Most cows with a high nursing index are hard workers and often look tired, while the poor milkers are sometimes the prettiest in the herd. Unfortunately, cattlemen without production records tend to get rid of the ragged-looking hard workers and keep the pretty loafers.

Greatest value of the nursing index is for selection *within* a herd. Improvement is slow but worthwhile in the long run. A bull out of a dam with a 115 nursing index, for example, is likely to sire heifers that tend to improve calf weaning weights.

There are 72 purebred and commercial breeders in Montana's association. The 1958 certified feeder cattle sold for at least a 2-cent premium, most of them for 4 to 6 cents extra. Bulls with A ratings sold as yearlings for about a \$200 premium solely on the basis of their certificates. Officers expect at least 16 certified calf crops in Montana this year, totaling some 1,800 head. ☆

Quicker Test for Potato VIRUS

New indicator plant, procedure reversal, and technique improvement cut test time in half

■ A TIME-CONSUMING STEP in developing potato varieties with multiple disease resistance—the step of checking for immunity to virus A—has been shortened and made more effective by new techniques devised at USDA's Agricultural Research Center, Beltsville, Md.

Virus A is transmitted to susceptible potato plants by aphids that feed on the leaves. Testing the plants is complicated by the existence of two forms of immunity—immunity to the virus itself and immunity to introduction of the virus into the plants by aphids. Furthermore, plants vary in their reaction to different tests. Screening of parental lines and selections for immunity to this virus has required up to 12 months for an involved series of field and greenhouse tests.

ARS plant pathologists R. E. Webb and E. S. Schultz (retired) have now found that reversing the sequence of the tests and performing all of them under the controlled environment of a greenhouse gives full evidence in less than half the usual time.

By earlier methods, all plants were first subjected to aphid infection in the field. Since the disease does not usually show up in plants infected by aphids, but rather

TURN PAGE

FRUITS & VEGETABLES · FRUIT



1. First step in new procedure is to graft each breeding selection to an infected plant (right) to see if the selection can pick up virus A. Diagonal cuts in selection and infected plant fit into one another and are held in place by ordinary clothespin (this technique was developed by E. S. Schultz).

Quicker Test for Potato Virus

(Continued)

in their offspring, tubers from these plants were harvested and seedlings were grown from them in the greenhouse. Definite identification of virus A in the seedlings was established by grafting to an *indicator* plant species, one which shows symptoms readily identifiable as those of virus A. Resistant selections found at this stage were aphid immune, but had to go through further tests so breeders would know which type of genetic immunity they were dealing with.

Two types of immunity are identified

Grafting seedlings (another generation) to plants infected with virus A gave the answer here. Selections that did not get the disease were of the first type—graft immune. Those that did receive the disease were of the second type—graft susceptible but aphid immune.

The key to development of the new techniques was discovery of a more effective indicator plant during screening tests of potato and related species of *Solanum* collected by plant-introduction scientists. Although the screening was made to detect *resistance* to potato diseases, Webb and Schultz realized the value of a *Solanum demissum* variety that showed distinct *susceptibility* to virus A. This variety (P. I. 175, 404) showed symptoms 4 to 6 days after inoculation with virus A. The best indicator plant in previous use, potato variety Green Mountain, took 30 to 40 days to show symptoms.

With quicker identification of virus A possible, the researchers took a new look at their procedures.

Graft-immune potatoes greatly outnumbered the others, since the selections were from progenies segregating for

graft immunity to virus A. If these plants could be eliminated from the tests first, a smaller number of plants would remain to test for aphid infection. And with fewer plants to test, aphid inoculation in the greenhouse would be feasible. Preliminary tests showed these theories were practical.

Here's how the new techniques work:

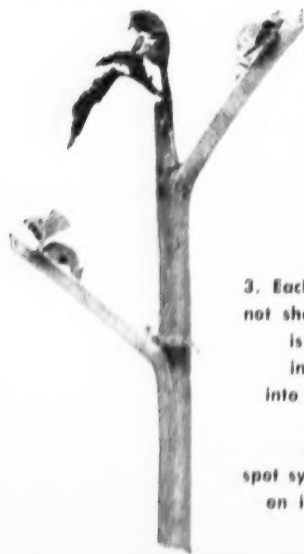
All plants to be tested are grafted to an infected carrier. Top necrosis, a hypersensitive reaction, about 35 days later marks the test plants which are graft immune. However, some graft-immune plants fail to show the hypersensitive reaction, so are not yet distinguished from graft-susceptible plants. Therefore, juice from the remaining tested plants—as low as 20 to 25 percent of the original number—is then inoculated into plants of the indicator host *S. demissum*. Those tested plants that are susceptible will produce a virus reaction in the indicator plant. All others are graft-immune.

This process reduces the number of plants to undergo aphid inoculation to about 15 percent. Seedlings of these plants are enclosed in ventilated plotholm cages in the greenhouse and infested with aphids previously fed on infected leaves. The seedlings are removed from the cages 24 hours later and incubated for 30 to 35 days. Indicator host plants are inoculated with juices from the seedlings and diagnosis of aphid immunity or susceptibility is made after 6 days.

New methods are simpler and more accurate

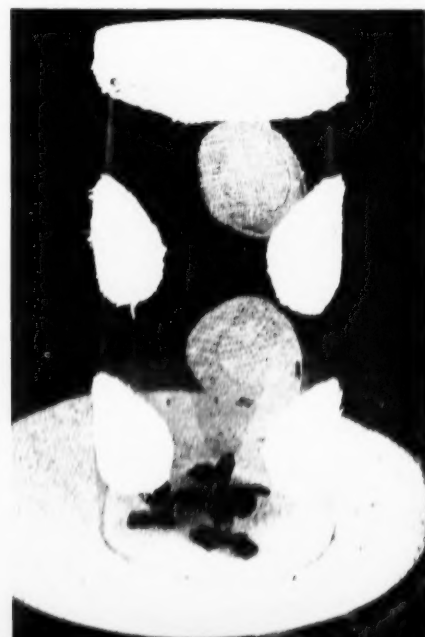
Besides saving time and space, the new techniques give a more reliable index of immunity and susceptibility. Field tests dependent on natural aphid inoculation of plants could not be completely effective because of the chance that aphid predators were also present. ☆

2. Some grafted selections show hypersensitivity (dead tip at left). This means they're immune to virus A and require no further tests.



4. Final step is to enclose susceptible selections from step 3 in cage with virus-carrying aphids. This will show whether plant can resist infection by aphids.

3. Each grafted plant not showing dead tip is next tested by injecting its juice into indicator plant. If selection is susceptible, leaf spot symptoms appear on indicator (right).



Rex cotton made good

Rex, an early-maturing, disease-resistant cotton released to growers 2 years ago, has lived up to expectations in recent growing tests.

ARS agronomists C. O. Moosberg (developer of Rex) and B. A. Waddle



grew this cotton at Marianna substation of the Arkansas Agricultural Experiment Station and found high seedling vigor, storm tolerance, and productivity and low production cost.

After several nights of strong winds and a temperature of 41° F. at Marianna, plant survival was 85 percent for Rex, but only 57 percent for the popular variety grown with it.

The tests showed that Rex's earliness comes from fast fruiting. Although the new variety didn't start blooming any earlier, it did bloom faster and more profusely and held onto its blossoms exceptionally well. It is not surprising, therefore, that Rex outyielded the three commonly grown local varieties for all planting dates. Plot research and grower experience for 2 years indicate that Rex can be grown at lower cost.

Spray for grain rust?

Chemicals may be used some day to help control rust in grain crops, three scientists agree—especially in epidemic periods and during the interval between the appearance of new rust races or strains and the development of resistant varieties.

Nickel chloride (rust eradicator) and Zineb (protectant used on some crops) seem to have greatest poten-

tial. Joint use of these chemicals protects the grain against rust for about 10 days, say USDA plant pathologist W. Q. Loegering, Canadian scientist F. R. Forsythe, and Gordon Brandeis, of a chemical concern.

There are, however, some prerequisites to chemical control in grain. We must learn whether a toxic residue remains from use of nickel chloride. And it must be cleared before use on food crops. We must also find out whether it will pay to use chemicals, and under what conditions.

Invention is in use

The USDA-developed cotton opener-cleaner has had wide acceptance in the industry since its release in 1957 (AGR. RES., May 1957, p. 15), according to recent reports.

This machine, developed at the ARS Southern utilization division, New Orleans, by R. A. Rusca and R. C. Young, combines bale-opening and blending with efficient cleaning.

Eighteen opener-cleaners are now used in textile mills, and others are on order. One large mill group plans to install 10 units this year.

Manufacturers are enthusiastic about this device and report savings up to \$100 a day per machine. It processes up to 1,600 pounds an hour and cuts spinnable-fiber loss in half by efficient trash removal.

Farmers have also benefited from the cotton opener-cleaner, because it broadened the usage of lower-than-normal grades of cotton.

Dix, new juice grape

Dix, a new grape, has just been released to growers to provide an intensely red juice for blending with that of less colorful juice grapes.

Berries of the new variety are black, medium-sized, and have a mild to neutral flavor. Both juice and pulp are intensely red. Tests at New Jersey Agricultural Experiment Station, New Brunswick, where Dix was developed cooperatively with USDA, showed the juice blends well with other less colorful grape juices.

Soluble solid content of Dix juice ranges from 14 to 17 percent, and acidity from 0.5 to 0.8 percent.

ARS horticulturist D. H. Scott of the Agricultural Research Center, Beltsville, Md., and pomologist E. G. Christ of the New Jersey station, report that Dix originated as a seedling from a cross of America and Bailey. Dix ripens at about the same time as Concord. The plants are vigorous, moderately productive, and about as resistant to foliage diseases as is Fredonia. Fruit clusters are medium to small, uniform in shape, and usually without a shoulder.

Dix has been tested extensively in New Jersey and Maryland, and has also been grown at nine eastern agricultural experiment stations.

Minimum-care woollens

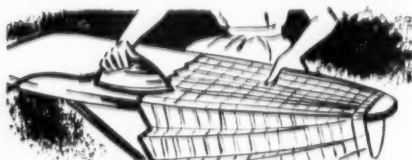
Minimum-care wool garments that keep their shape, size, pleats, and good looks after long wear and many machine washings have been experimentally produced through USDA research. The small amount of resin used for the treatment affects only slightly the drape, resiliency, and the way wool feels to the touch.

These desirable new properties in wool were obtained through treatment with a modified epoxy resin. Researchers at the ARS Western utilization division, Albany, Calif., developed the treatment and are now trying to refine it. This treatment is

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one of the most recent developments in continuing ARS study of many chemical modifiers and fiber structure to improve wool's usefulness.

Treated wool flannel slacks showed



no shrinkage in tests after extreme laundering, compared to a 30-percent shrinkage by untreated slacks. Only light touchup pressing was needed to restore original appearance. Creases stayed in treated slacks well, even after severe exposure to rain and overnight wear on an airplane trip.

Pleated wool skirts treated with the resin washed well and needed only light pressing to look neat again. Resin-treated wool socks withstood shrinkage even after 35 washings and lasted longer than the untreated ones.

While there are still problems to solve, results assure us that commercially acceptable minimum-care wool garments are a definite possibility.

Help for Truck Crops

Weeds commonly infesting onions and sweet corn have recently acquired two powerful herbicide enemies as a result of USDA research.

ARS weed-control studies at Weslaco, Tex., in cooperation with the Texas Agricultural Experiment Station, showed that CDEC (2-chloro-allyl diethyldithiocarbamate) as a pre-emergence herbicide effectively

controlled weeds in onions with no crop damage. Simazin, applied on sweet corn as pre-emergence treatment at Agricultural Research Center, Beltsville, Md., also proved effective.

ARS horticulturist R. M. Menges showed that applying 3 pounds of CDEC in 40 gallons of water per acre controlled pigweed and watergrass in onions. Six pounds of CDEC in 40 gallons of water controlled weeds but decreased the stand of onions.

Simazin pre-emergence spray controlled annual grasses and broad-leaved weeds in sweet corn without affecting the corn's yield, quality, palatability, or maturity date, according to ARS weed researcher L. L. Danielson. A four-pound application gave best results, but lower spray concentration was effective and practical with limited cultivation.

Herbicides and water

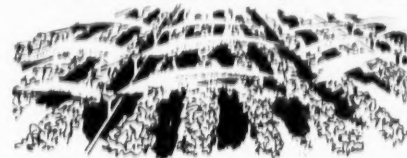
Overhead irrigation proved more effective than furrow irrigation for weed control in recent USDA-State studies using several pre-emergence herbicides at Weslaco, Tex.

ARS horticulturist R. M. Menges reported that downward movement of herbicides increased with overhead irrigation. Furrow irrigation tended to leave the chemicals on soil surface away from germinating weed seeds.

Studies using 4 pounds of either CDEC (2-chloroallyl diethyldithiocarbamate) or EPTC (ethyl N,N-di-n-propylthiocarbamate) to 40 gallons of water, showed 97-percent weed

control with overhead irrigation, but 61 percent with furrow irrigation.

Weed-control percentages with fur-



row irrigation approached those with overhead irrigation when the amounts of the herbicide applications were increased. However, heavy applications of weed killers increase production cost and may endanger crops.

Better seed inoculation

A USDA-developed method of inoculating legume seeds gives them a better chance of growing in dry soil.

The new treatment—mixing seeds and inoculant with corn syrup or molasses instead of the conventional water—eliminates the risk of the bacteria dying from lack of moisture in dry soils. Corn syrup or molasses will save bacteria for 2 to 3 weeks, but farmers are advised to reinoculate if it doesn't rain in this period.

In ARS tests in dry North Carolina soils, the corn-syrup or molasses mixers increased alfalfa-hay yield 84 percent over the conventional water-inoculant procedure.

Note this correction

The figure of 1,134 grams of sulfaquinoxaline quoted on page 7 of AGRICULTURAL RESEARCH, December 1958, should read 113.4 grams.